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INVESTIGATION OF CRYSTAL AND MAGNETIC STRUCTURES OF MULTIFFERROIC MATERIAL UNDER HIGH PRESSURE

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Magnetoelectric multiferroics, where a ferromagnetic and a ferroelectric order coexist and are coupled in a single phase, have been a hot topic in condensed matter physics for a long time owing to their ability to facilitate next generation applications. Mainly, understanding of the magnetoelectric effect in single-phase materials is one of the most exciting and interesting topics of research in the solid-state physics. Pb(Fe2/3W1/3)O3 (PFWO) belongs to the family of Pb-based multiferroic relaxor ferroelectric complex perovskites (AB′1−xB′′xO3). It is generally accepted that this material exhibits a disordered perovskite structure, where Fe3+ and W6+ ions are randomly distributed at the centers of the BO6 octahedra. However, recently studies have revealed the presence of the set of superlattice reflections, which indicates some kind of B-cation ordering in PFWO which had been thought to be totally disordered. It was found that the crystal structure of PFWO should be described by a partly ordered cubic perovskite (i.e. Fm−3m), also, the weak ferromagnetic properties and excess magnetic moment of PFWO can be understood based on non-random distribution of Fe cations between the 4a and 4b sites. Despite intensive studies, understanding the exact nature of its multifunctional properties of PFW has remained a challenge for decades. The knowledge of relationship between magnetic and crystal structure of such compounds, which can be obtained from high-pressure investigations, is very essential for understanding the nature and mechanism of physical phenomena observed in it. In addition, the detail studies of structural changes under extreme conditions were not carried out.
In present work was performed neutron diffraction studies of PFWO at high pressures and low temperature. Neutron powder diffraction measurements at high pressures up to 7 GPa were performed with the DN-12 diffractometer at the IBR-2 high-flux pulsed reactor [FLNP, JINR, Dubna, Russia] using the sapphire anvil high-pressure cell. In order to improve the understanding of the lattice instabilities the Raman spectroscopy studies of the vibration spectra of the compound under pressure up to 30 GPa were performed. The crystal structure of this compound also has been studied by X-ray diffraction at high pressures. Pressure dependences of the volume, unit cell parameters and of magnetic moments of antiferromagnetic (AFM) phase, Neel temperature were also calculated. With increasing temperature and pressure, slight decreasing of the magnetic moments of iron ions in PFWO were observed, however, although the crystal structure remains stable up to high pressures with a space group Pm-3m. Some Raman modes have been found on the Raman spectra, which in such compounds are correlated with the existence of nanoregions, however, with increasing pressure, these modes noticeably widen and vanish.
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The speaker is a student or young scientist

Yes

Section

1. Synchrotron and neutron radiation sources and their use in scientific and applied fields

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